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<p>(54) Title: ANCHORING MEANS FOR A JOINT PROSTHESIS OR OTHER COMPONENT</p> <p>(57) Abstract</p> <p>An anchoring means for a joint prosthesis (4) tapers in a direction away from the joint prosthesis (4) but may be mounted in a bore through an inlet opening distal from the joint to be replaced. The anchoring means may comprise a tapering pin (53) which is cemented in place. Alternatively, the anchoring means may comprise a pin (3) and one or more retaining means (2, 3) which can be placed in the bore separately and manoeuvred such that the anchoring means tapers. Thus, a tapering anchoring pin is provided for a minimally invasive joint replacement technique.</p>		

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ANCHORING MEANS FOR A JOINT PROSTHESIS OR OTHER
COMPONENT

5 This invention relates to anchoring joint a
protheses or other component in a bone and, more
particularly, to anchoring means for anchoring a joint
prosthesis or other component, and a method of fitting
the anchoring means, in a bone.

10 It is a well known medical technique to replace
worn out, damaged or diseased joints in human and animal
~~bodies with artificial joint prostheses.~~ Such
prostheses may, for example, comprise a replacement
joint articulation, such as a metal ball and socket or
15 other pivotal means. Alternatively, the joint prosthesis
may replace only part of the joint. For example, the
ball of a ball and socket joint may be replaced with a
joint prosthesis comprising an artificial replacement
ball designed to sit in the original socket of a natural
20 joint.

 Thus, it is intended for the purposes of this
application that the term 'prosthesis' or 'joint
prosthesis' is not limited to a component which takes
the form of a natural joint, but is intended to include
25 any component for replacing part or all of the function
of a natural joint.

 Regardless of whether the joint prosthesis replaces
all or part of a joint, the joint prosthesis, or parts
of the joint prosthesis, needs to be anchored in or
30 located on bone adjacent or near to the joint. Joint
prostheses therefore generally further comprise means
for anchoring the replacement articulation, joint
surface or joint part in a bone. For example, a joint
prosthesis for replacing a natural ball and socket
35 joint, such as the human shoulder or hip, often has a
replacement articulation comprising a replacement ball
and socket. The replacement ball may be carried on or

formed integrally with anchoring means comprising a pin arranged to be inserted in the medullary canal of a bone, such as the femur or humerus, after the natural ball has been removed. The replacement socket may be carried in or formed integrally with anchoring means comprising a cup which is arranged or shaped to be cemented into the bone surrounding the socket, such as the acetabulum (hip bone) or scapula (shoulder blade). Alternatively, the replacement socket may be carried on or formed integrally with anchoring means comprising a pin which is inserted into an artificial bore in the acetabulum (hip bone) or scapula (shoulder bone).

Procedures for fitting joint prosthesis are generally very invasive. Joints are buried deep in the human or animal body, so to replace natural joints with joint prostheses and to insert anchoring means into bone around a joint requires a large amount of tissue, including muscle, ligaments and cartilage which support the joint to be cut. This leads to a long recovery time for joint replacement operations and a large failure rate. More recently, however, less or "minimally" invasive surgical techniques have been developed for joint replacements. Such a technique is disclosed in the Applicant's International Patent Application No. WO98/34567, where it is disclosed to carry out a joint replacement by inserting the replacement parts through a bore in a bone. Such a bore is made through an incision distal from the joint being replaced and this reduces trauma to the tissue surrounding the joint.

According to a first aspect of the present invention there is therefore provided, a hip prosthesis comprising a first fastening assembly intended for being mounted in the hip bone and an anchoring means intended for being mounted in the top end of the femur, wherein the first fastening assembly and the anchoring means are interconnected by means of a pivotable connection, wherein all parts of the hip prosthesis are so small

and/or slender that they can each be arranged in the intended end position thereof via a bore in the femur, which bore extends from the lateral outer side of the femur through the femoral neck substantially in the direction of the imaginary longitudinal centre line of the femoral neck to the femoral head, wherein the anchoring means of the hip prosthesis in mounted condition comprises a tapering part, with a relatively wide, medial side of the tapering part being located adjacent the femoral neck, while a relatively narrow, lateral side of the tapering part is located adjacent the outer side of the femur.

The anchoring means, and indeed the whole hip prosthesis, may therefore be fitted using a minimally invasive technique, in which all access to the joint is gained through the bore in the bone. This vastly reduces trauma to the area of the joint, and therefore shortens recovery time and reduces failure rate.

A joint prosthesis similar to this can equally advantageously be used to replace other human and animal joints, in particular the human shoulder joint. However, the type of articulation can vary, as can the position of the bore. Similarly, the joint prosthesis may replace only a part of a natural joint, such as only the ball of a ball and socket joint.

Thus, according to a second aspect of the present invention there is provided a joint prosthesis having components which are sufficiently small and slender that the joint prosthesis is mountable through an extra-medullary bore in a bone from a position distal to the intended position of the prosthesis, the joint prosthesis having an anchoring means which is mountable in the bore and tapers such that its narrow end is remote from the joint when mounted.

Also, according to a third aspect of the present invention there is provided a method of fitting a joint prosthesis comprising inserting the joint prosthesis

through an extra-medullary bore in a bone from a position distal to the intended position of the prosthesis, and mounting a tapered anchoring means for or of the joint prosthesis in the bore such that its narrow end is remote from the joint when mounted.

The term 'extra-medullary bore' generally refers to any bore not along the same axis as the medullary canal of a bone and, in particular, includes any bore across or through a bone.

These aspects of the invention are advantageous in that, in a minimally invasive procedure, the tapered anchoring means provides stable support in the direction of its main axis toward the joint. In other words, as force is exerted on the anchoring means by the joint under natural loading, such as by standing or walking on a hip, the axial force exerted on the anchoring means is supported by the taper and the anchoring means will fit more and more tightly into the bore. Thus, the joint prosthesis is held very stably in the bone.

However, it will be recognised that this approach is, to an extent, counter-intuitive since the tapered anchoring means is inserted into the bore in a bone, from a position remote from the joint, wide end first.

In particular, when the anchoring means is tapered before insertion into the bore (e.g. has a permanent taper), the widest part of the anchoring means (proximal to the joint) must be inserted first, as the anchoring means is inserted into the bore from a position distal from the joint and tapers away from the joint. Thus, the bore distal from the joint must be at least as wide as the widest part of the anchoring means and, when the anchoring means is in position, the diameter of the bore in the region of the narrower end of the anchoring means (distal to the joint) is larger than the diameter of the anchoring means and the anchoring means does not fit tightly into the bore.

In a first group of embodiments of the invention,

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which can avoid the use of cement, it is therefore preferable for the anchoring means to be radially expandable in the bore.

5 This enables the anchoring means to be inserted into the bore and then wedged into position. For example, the whole anchoring means may be radially expanded. Alternatively, the anchoring means may be inserted in the bore in component parts, some of which may be tapered. The component parts may be then moved
10 in the bore longitudinally with respect to one another such that the diameter of the anchoring at a given point along its length increases. Regardless, the effect of the radial expansion is to wedge the anchoring means in position.

15 The bore may be uniformly cylindrical or itself tapered. A straight, uniformly cylindrical, bore is easier to make in the bone and may allow components of the joint prosthesis to be inserted through the bore into their intended position easily. A tapered bore
20 fits a tapered anchoring means more stably, but may have smaller dimensions at the end of the bore remote from the joint than a uniformly cylindrical bore with the result that the components of the joint prosthesis may need to be smaller and/or more slender.

25 This type of expandable anchoring means may be used in conventional invasive surgical techniques and not just minimally invasive procedures. Furthermore, the anchoring means may be used to fix other components for fitting in bones in human or animal bodies, not just
30 joint prostheses, in place. For example, an expandable anchoring means may be used to secure a component comprising a plate that is fitted to the outside of a broken or fractured bone for support.

35 Thus, according to a fourth aspect of the present invention, there is provided a component for fitting to or in a bone, the component having an anchoring means insertable into a bone cavity and radially expandable in

the bone such that the anchoring means has a tapered configuration, with the narrow end of the taper furthest from the component.

5 The bone cavity may, in this aspect, be a naturally occurring bone canal, or may be a bore formed by a surgeon especially for the prosthesis.

Also, according to a fifth aspect of the present invention, there is provided a method of anchoring a component to or in a bone, the method comprising
10 inserting an anchoring means into a cavity in the bone, radially expanding the anchoring means in the cavity such that the anchoring means has a tapered configuration with the narrow end of the taper furthest from the component.

15 In particular, the anchoring means may be radially expandable such that its outermost diameter exceeds the diameter of an inlet opening of the cavity. Thus, once the anchoring means has been expanded it is unable to pass through the inlet opening and this provides
20 particularly secure fixation.

In a preferred embodiment of the above aspects, the anchoring means comprises a pin and one or more retaining elements, at least one of the pin and/or retaining element being tapered. The pin and retaining
25 element(s) can be inserted in the bore separately or together, but can be moved relative to one another, substantially in the direction of their major axes, such that the diameter of the anchoring means is be increased and a tapered, wedging effect is obtained.

30 Preferably the anchoring means has two retaining elements sandwiching the pin. This provides more stable location in the bore as the pin may extend substantially along the major axis of the bore and an even load may be exerted on the retaining elements.

35 If the anchoring means is expanded to suitable dimensions it may be fitted into the bore without the need for cement, which is used to fix most conventional

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joint prosthesis in place. However, the anchoring means may additionally or alternatively be cemented into position.

5 Cement provides secure fixing of the anchoring means into the bone as it takes the exact form of the bore, and may seep into the bone surrounding the bore, before setting. However, one difficulty in cementing an anchoring means in a bore through a bone from only one end, as required in the minimally invasive technique
10 described above, is that it is difficult to prevent cement from leaking from the other end of the bore as it is injected, particularly as it is preferable to pressurise the cement to drive air and fluid out of the bore in order to obtain proper fixation.

15 Where the invention is adapted for use with cement, it is preferred that the anchoring means is provided with a seal for sealing the anchoring means in the bore, at an end of the bore distal to an end through which cement is injected. Thus, one end of the bore is
20 sealed and cement can be injected under pressure from the other end of the bore without leaking from the sealed end, for example into a joint cavity.

However, this type of anchoring means could be inserted into a bore in a bone from either end. It may
25 therefore be used in conventional invasive surgical procedures. Furthermore, whilst a tapered anchoring means is preferred, this may not be essential if the anchoring means is cemented in position, since the seal enables cement to be injected under pressure from one
30 end of the bore and adequate fixation may be obtained with other shapes of anchoring means.

Thus, according to a sixth aspect of the present invention, there is provided an anchoring means for a component for fitting to or in a bone, the anchoring
35 means insertable in a bore and having a seal for sealing the anchoring means in the bore at an end of the bore distal to the end through which cement is injected for

cementing the anchoring means in place.

Also, according to a seventh aspect of the present invention, there is provided a method of cementing an anchoring means in a bore through a bone comprising
5 inserting the anchoring means in the bore, sealing the anchoring means in the bore at one end, and injecting cement into the other end of the bore.

Thus, the bore is sealed in order that cement can be injected around the anchoring means in the bore
10 without leaking past the seal, for example, into a joint cavity and interfering with a joint. The seal may also facilitate placement of the anchoring means along the central axis of the bore and hold it there while the cement sets. Thus, a tapering anchoring means can be
15 inserted from a position distal to the joint, yet still be anchored securely in the bone.

If cement is used, it is preferable that the anchoring means comprises a single part. This provides increased strength and durability over an anchoring
20 means comprising several sections.

Preferably, the seal is an annular ring around the end of the anchoring means distal from where cement is introduced. Alternatively, the seal may be an annular cap having an annular recess for engaging a resected end
25 surface of the cortical bone wall of the bone. Another alternative is for the seal to comprise an inflatable "O"-ring. The anchoring means may then further comprise an internal passage for inflating the "O"-ring with air or any other suitable medium.

In a preferred embodiment, an additional seal may be provided at the end of the bore where cement is provided, such that there is a cavity between the seals surrounding the anchoring means into which cement may be introduced under pressure, for example via an orifice in
30 the second seal. The second seal may also be an annular ring extending around the anchoring means in order to assist in its axial location.
35

In the context of more standard surgical techniques in which anchoring means for prosthesis are inserted into a bone cavity or bore from the side facing the joint, the provision of the cement seal at the opening where the cement is introduced may be more significant, since the other end of the cavity or bone may terminate within the bone and therefore be effectively sealed already.

Hence, a further aspect of the invention provides a prosthesis having an anchoring means configured for mounting in an extra-medullary bore in a bone, one end of the anchoring means being provided with an annular seal through which cement may be forced into the bone in use.

A further aspect of the invention provides a method of anchoring a prosthesis in an extra-medullary bore in a bone, comprising locating a tapered anchoring component in the bore, sealing the bore opening and forcing cement under pressure into the bore with the anchoring means positioned therein.

In the context of a hip replacement, the bore preferably extends along approximately the imaginary longitudinal centre line of the femoral neck and the prosthesis in an artificial ball joint.

These latter aspects can provide a less invasive technique and a firmer mounting than standard hip replacement procedures.

One of the fundamental advantages of the invention is the stable support provided for a joint prosthesis by a tapering anchoring means. This is particularly advantageous for hip prosthesis which may bear a large load and therefore require particularly stable support.

According to a further aspect of the present invention there is therefore provided a hip prosthesis having an anchoring means for supporting the prosthesis in an extra medullary bore in a femur, the anchoring means being tapered away from the prosthesis and

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extending only part way through the femur.

Thus, a relatively small and simple anchoring means may be used to support the hip prosthesis, yet this still provides stable and strong support for the prosthesis. Such an anchoring means is relatively cheap to produce and causes far less trauma to the femur than conventional femoral components for hip prostheses which sit in the medullary canal of the femur or extend all the way across the bone.

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of the top of a femur in which an anchoring means according to a first exemplary embodiment of the invention has been fitted;

Fig. 2 is a cross-sectional view of the anchoring means of Fig. 1, taken on the line II-II of Fig. 1;

Fig. 3 is a sectional view similar to that of Fig. 1, showing an anchoring means according to a second exemplary embodiment of the invention;

Fig. 4 is a cross-sectional view of the anchoring means of Fig. 3, taken on the line IV-IV of Fig. 3;

Fig. 5 shows a detail of the cross-sectional view of Fig. 4;

Fig. 6 is a sectional view similar to Fig. 1, showing an anchoring means according to a third exemplary embodiment of the present invention;

Fig. 7 is a sectional view similar to Fig. 1, showing an anchoring means according to a fourth exemplary embodiment of the present invention;

Figs. 8a-8e show some steps for mounting the anchoring means shown in Fig. 1 in a femur;

Fig. 9 is a sectional view similar to Fig. 1, showing an anchoring means according to a fifth exemplary embodiment of the present invention;

Fig. 10 is a close-up sectional view similar to Fig. 1, showing an anchoring means according to a sixth

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exemplary embodiment of the present invention; and

Fig. 11 is a close-up sectional view similar to Fig. 1, showing an anchoring means according to a seventh exemplary embodiment of the present invention.

5 Joint prostheses may be used to replace virtually all joints in the human and animal body. Likewise, this invention may be used in the replacement of any joint in the human and animal body. However, it is particularly applicable to the replacement of hip and shoulder joints and, for convenience, preferred embodiments will be described with reference to the replacement of the human
10 ~~hip joint, and relate, in particular, to a hip~~
prosthesis in accordance with than described in International Patent Application No. WO98/34567.

15 In the Figures, only an anchoring means of different embodiments of a hip prostheses is shown. An example of a possible embodiment of a complete hip prosthesis may be found in International Patent Application WO98/34567, the subject matter of which is
20 to be regarded as being inserted herein. The Figures show different exemplary embodiments for fitting an anchoring means (the second fastening assembly of WO98/34567) in a femur F. As is described in detail in WO98/34567, the parts of the hip prosthesis are
25 preferably designed such that they can all be placed into their end positions through a bore in the femur, which bore extends from the lateral outer side F_o of the femur F through the femoral neck F_n . The bore may be substantially in the direction of the imaginary
30 longitudinal centre line of the femoral neck to the femoral head. During the positioning of the hip prosthesis, a relatively small incision is made in the leg, providing access to the lateral outer side of the femur F. Next, a bore is made in the femur F as
35 described hereinabove. Via this bore, the femoral head is removed with a special tool, described in the above-cited International Patent Application. Next, parts of

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the joint prosthesis can be mounted in the hip bone via the bore in the femur F. After the positioning of the first fastening assembly, the anchoring means of the invention can be mounted. In the present exemplary
5 embodiments, the anchoring means, in mounted condition, comprises a tapering part C. A wide, medial side CM of the tapering part C is located more adjacent the femoral neck F_n , while a narrower, lateral side CL of the
10 tapering part C is located more adjacent the outer side F_o of the femur F. Because the tapered part C tapers from the medial to the lateral side or away from the joint
articulation, the hip prosthesis, when the leg is subjected to a normal load, is pressed into the bore in the femur F more and more tightly. Hence, the specific
15 geometry provides the anchoring means with a self-locking action.

In all exemplary embodiments shown in Figs. 1-7, the anchoring means comprises a pin 3, respectively 13, 33, 43. The pin 3, 13, 33, 43 has a free, medial end
20 thereof provided with means for forming at least a portion of the pivotable connection. In the present exemplary embodiments, this portion is designed as a ball 4, 14, 34, 44 of a ball joint. It is readily understood that other pivotable connections are also
25 possible. For this, reference is made to WO98/34567. The anchoring means of the present exemplary embodiments also comprises two retaining elements, respectively 1, 2; 11, 12; 31, 32; 41, 42. The retaining elements 1, 2; 11, 12; 31, 32; 41, 42 in mounted condition bound a hole
30 into which the pin 3, 13, 33, 43 is at least partially inserted. In the present exemplary embodiments, the two retaining elements 1, 2; 11, 12; 31, 32; 41, 42 taper from a medial end CM proximal to the pivotable connection, to a lateral end CL. The retaining elements
35 1, 2; 11, 12; 31, 32; 41, 42 are dimensioned such that they can be moved through the bore in the femur F as long as the pin 3, 13, 33, 43 is not yet fitted or

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inserted far enough into the hip joint cavity or bore.

The exemplary embodiments of Figs. 1-6 comprise a pin 3, 13, 33 having a constant sectional profile at least over a part of its length. The hole bounded by the two retaining elements 1, 2; 11, 12; 31, 32 likewise has a substantially constant sectional profile, into which the part of the pin 3, 13, 33 with the constant sectional profile is at least partially inserted. Such construction has the advantage that the retaining elements 1, 2; 11, 12; 31, 32 can be moved into their end positions, whereupon the pin 3, 13, 33 can be positioned.

Because in such embodiments, the pin 3, 13, 33 can still move relative to the retaining elements 1, 2; 11, 12; 31, 32, means for connecting the retaining elements 1, 2; 11, 12; 31, 32 and the pin 3, 13, 33 is provided.

In Fig. 1, these means are formed by screw thread 5 provided on the pin 3. The retaining elements 1, 2 have their lateral ends provided with internal screw thread mating with the screw thread 5 on the pin 3. To prevent the pin 3 from moving after it is rotated into a specific position, a locking means is provided which in the present exemplary embodiment comprise a sleeve 6 having an end wall. The sleeve 6 embraces or surrounds the lateral ends of the retaining elements 1, 2. Means for connecting the sleeve 6 to the pin 3 is also provided and, in the present exemplary embodiment, the means for connecting the sleeve 6 to the pin 3 comprise a bolt 7. Provided in the end wall of the sleeve 6 is an end wall bore 9. In line with this end wall bore 9, a pin bore 8 is provided in the pin 3, substantially along the major axis of the pin 3. The bolt 7 passes through the end wall bore 9 and engages the pin bore 8. As the bolt 7 is tightened, the sleeve 6 is drawn further over the lateral ends of the retaining elements 1, 2. Because these lateral ends are of a slightly tapered design and, moreover, the inner circumferential

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wall of the sleeve 6 is also of tapered design, the retaining elements 1, 2 are pressed together when the bolt 7 is tightened, causing the pin to be clamped between the retaining elements 1, 2. Moreover, the
5 pulling force exerted by the bolt 7 prevents rotation of the pin 3 relative to the retaining elements 1, 2, by the friction occurring in the screw thread connection 5.

In the exemplary embodiment shown in Fig. 3, the pin 13 has a constant sectional profile, viewed in the
10 longitudinal direction of the pin 13. As Fig. 4 clearly shows, in the transverse direction, the pin 13 is provided with tapered faces 15 which are receivable in the hole bounded by the retaining elements 11, 12. In the present exemplary embodiment, the tapered faces 15
15 and the hole formed by the retaining elements 11, 12 are provided with serrated or snap edges preventing an axial displacement of the pin 13 relative to the retaining elements 11, 12. To ensure that the tapered faces 15 of the pin 13 are properly pressed into the associated
20 opening in the retaining elements 11, 12, this exemplary embodiment, too, has locking means comprising a sleeve 16 having an end wall with an opening 19 provided therein. The sleeve 16 is tightened by means of a bolt 17 engaging a pin bore 18. Because this sleeve 16, too,
25 comprises tapering circumferential walls 20, the retaining elements 11, 12 will be pressed together during tightening of the bolt 17. When the retaining elements 11, 12 are being moved together, the tapered faces 15 of the pin 13 engage the associated tapered
30 faces in the retaining elements 11, 12 more and more tightly. The serrated snap edges of the tapered faces 15 which are clearly shown in the detail of Fig. 4 shown in Fig. 5 provide a firm connection between the pin 13 and the retaining elements 11, 12. The tapered outer
35 surface C of the retaining elements 11, 12 provides that when the hip prosthesis is subjected to a normal load, the fastening assembly is pressed into the femur F more

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and more tightly.

In the exemplary embodiment shown in Fig. 6, the means for connecting the retaining elements 31, 32 and the pin 33 are exclusively formed by a screw thread 35
5 provided on the pin 33 and mating with internal screw thread provided on the inside of the retaining elements 31, 32.

Unlike the previous exemplary embodiments, the exemplary embodiment shown in Fig. 7 has a pin 43
10 tapering over at least a part of the length thereof. The tapered pin part tapers to the lateral end 43L,
viewed from the medial end 43M. Viewed from the medial to the lateral end of the hole, the hole bounded by the two retaining elements 41, 42 has a tapering sectional
15 profile in which the tapering pin part 43 is at least partly received. Here, the connection between the retaining elements 41, 42 and the pin 43 is effected by drawing the pin 43 continuously to the lateral side. This is effected in that the means for connecting the
20 retaining elements 41, 42 to the pin 43 comprise a drawing plate 46 and a wire of memory metal 45. The wire of memory metal 45 is by a first end thereof connected to a medial end 43M of the pin 43. The second end of the wire 45 is connected to a drawing plate 46.
25 In mounted condition, the drawing plate 46 abuts against the outer side F_o of the femur F at the location of the lateral end of the femoral bore. The wire of memory metal 45 is designed such that at body temperature it tends to shorten, causing a tensile stress in the wire.
30 During positioning of the wire 45, it is in a stretched condition, so that during positioning some play is present for fitting the pin 43 and the retaining elements 41, 42. Although in the Figure the retaining elements 41, 42 have a slightly tapered configuration,
35 this is not required, because the tapered configuration of the anchoring means may be entirely provided by the pin 43.

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In the exemplary embodiment shown in Fig. 7, the retaining elements 41, 42 are moreover further provided, at their medial ends, with a collar 47, 48 intended for engagement with the cortical bone edges bounding the medial opening of the femoral bore. If necessary, such collar could also be provided in the other exemplary embodiments.

Figs. 8a-8e show the successive steps for mounting the anchoring means shown in Fig. 1. First, the retaining element 1 is positioned (Fig. 8a); then, the retaining element 2 is positioned (Fig. 8b); after that, the pin 3 is provided in the hole bounded by the retaining elements 1, 2 (Fig. 8c); then, the sleeve 6 is slid over the lateral ends of the retaining elements 1, 2 (Fig. 8d). Finally, the bolt 7 is tightened, after which the anchoring means has been mounted in the femur F (Fig. 8e).

It is observed that before the pin is positioned, the retaining elements may temporarily be slid slightly deeper into the joint, as a result of which the hole bounded by the retaining elements 1, 2 is slightly wider for inserting the pin 3 therein. The retaining elements 1, 2 may subsequently be pulled back in lateral direction into their end positions, after which the connection between the pin 3 and the retaining elements 1, 2 is effected.

The above embodiments all have two retaining elements 1, 2; 11, 12; 31, 32; 41, 42. However, all of these embodiments may be modified by providing only a single retaining element 1, 2; 11, 12; 31, 32; 41, 42. For example, referring to Fig. 1, the retaining means 2 may be formed integrally with the pin 3, such that the anchoring means substantially comprise only two elongate components; the pin 3 and retaining means 1. Alternatively, the retaining means 2 can be omitted and the bore made to different dimensions such that the upper surface of the pin 3 (as shown in Fig. 1) contacts

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the bone directly.

Referring to Fig. 9, in a fifth embodiment of the present invention a pin 53 has a substantially conical shape, tapering from a medial end, proximal to a joint articulation 54 to a lateral end, distal to the joint articulation 54. The pin 53 may be arranged to fit directly into a prepared bore in a femur from the location of the prosthesis, i.e. using a conventional (invasive) surgical technique. In that case, the pin 53 is shorter than shown in Figure 9 in order that it extends only part way through the femur F and the cortical bone wall opposite the joint articulation 54 remains intact, i.e. the bore does not extend all the way through the femur F.

However, the example shown in Figure 9 is suitable for use in a minimally invasive surgical technique such as that described in WO98/34567 and has a medial seal 51 is provided at its proximal end around the circumference of the pin 53. The medial seal 51 is generally annular. A lateral seal 52 is provided at the lateral end of the pin 53 distal from the joint articulation 54, which is again annular and disposed around the circumference of the pin 53.

The pin 53 is fitted in a bore 55, in this example in a femur F. The medial seal 51 seals the medial end of the bore and helps to locate the pin 51 centrally in the bore. The lateral seal 52 is then fitted at the distal end of the pin, and seals the lateral end of the bore. There is a cement delivery orifice 58 in the lateral seal 52 through which cement is injected into an elongate annular space 57 between the pin 53 and the bore. The cement is delivered at a pressure generally higher than normal blood pressure in order that any fluid is driven out of the space 57 and the cement abuts the bone over the whole exposed inside surface of the bore. Preferably, the cement also permeates the Spongiform bone of the inside of the femur surrounding

the bore to some degree dependent on the type of cement used and the pressure it is delivered at. This provides a more secure interface between the cement and bone F when the cement has set.

5 When the cement sets, the pin 53 is held rigidly in the bore. Any force exerted from the joint articulation end of the pin 53, for example through weight put on the hip prosthesis in use, forces the pin 53 towards its lateral or distal end, and due to the taper of the pin
10 53 forces the cement radially outwards. Thus, if the pin 53 moves at all, it pushes more and more tightly into the femur.

 In Fig. 9, the bore is shown as uniformly cylindrical. The bore may, however, be generally
15 conical, tapering in the same direction as the pin 53.

 Referring to Fig. 10, a sixth embodiment of the present invention is largely similar to the fifth embodiment shown in Fig. 10. However, in this example,
20 a cap 60 is provided to seal the end of the bore proximal to the joint articulation 64.

 The cap 60 has an annular recess 61 which holds a gasket or seal 62. The seal engages a rim of cortical bone around a resected femoral neck to seal the bore and hold the cap 60 in place. An annular resilient means 65
25 is provided inward of the recess 61 which presses against the inside surface of the cortical bone wall of the femoral neck to fit the cap 60 more securely. The resilient means 65 need not be annular and plural separate resilient means can be provided around the cap
30 60 instead.

 The pin 63 extends through the cap 60 and is attached to the cap 60 by an external screw thread 66 on the pin 63. The cap is put in place first, and the pin 63 is then located and screwed into the cap 60. Due to
35 the dimensions of the cap 60, if it is required to pass the cap 60 through the femoral bore to put the cap 60 in place for example when using the minimally invasive

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technique described above, the cap 60 is collapsable or made from deformable material to fit through the bore. The screw thread 66 may self tap into soft material disposed on the cap 60 or engage a screw thread on the cap 60.

Referring to Fig. 11, a seventh embodiment of the present invention is again largely similar to the fifth embodiment shown in Fig. 9. However, in this embodiment the medial seal 55 shown in Fig. 9, is an annular inflatable seal 70. The inflatable seal is connected to an air passage 71 inside the pin 73.

~~Thus, when the pin 73 is fitted, the seal is~~
inflated such that it locates the pin 73 centrally in the bore and seals the medial or proximal end of the bore.

It may be understood that the invention is not limited to the exemplary embodiments described, but that various modifications are possible within the scope of the invention defined in the claims.

CLAIMS

1. A hip prosthesis comprising a first fastening assembly intended for being mounted in the hip bone and
5 an anchoring means intended for being mounted in the top end of the femur (F), wherein the first fastening assembly and the anchoring means are interconnected by means of a pivotable connection, wherein all parts of the hip prosthesis are so small and/or slender that they
10 can each be arranged in the intended end position thereof via a bore in the femur (F), which bore extends from the lateral outer side (F_o) of the femur (F) through the femoral neck (F_n) substantially in the direction of the imaginary longitudinal centre line of the femoral
15 neck (F_n) to the femoral head, wherein the anchoring means of the hip prosthesis in mounted condition comprises a tapering part (C), with a relatively wide, medial side (CM) of the tapering part (C) being located adjacent the femoral neck (F_n), while a relatively
20 narrow, lateral side (CL) of the tapering part (C) is located adjacent the outer side (F_o) of the femur (F).
2. A joint prosthesis (4) having components which are sufficiently small and slender that the joint prosthesis
25 is mountable through an extra-medullary bore in a bone (F) from a position distal to the intended position of the prosthesis, the joint prosthesis having a tapered anchoring means (C) which is mountable in the bore such that its narrow end is remote from the joint (4) when
30 mounted.
3. The prosthesis of claim 1 or claim 2, wherein the anchoring means is radially expandable in the bore.
- 35 4. The prosthesis of any one of the preceding claims, the anchoring means comprising a pin (3) and one or more retaining elements (1, 2), at least one of the pin (3)

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and/or retaining element(s) (1, 2) being tapered.

5 5. The prosthesis of claim 4, the anchoring means /
having two retaining elements (1, 2) sandwiching the pin
(3).

10 6. The prosthesis of any one of the preceding claims,
the anchoring means having a medial seal (51) for
sealing the medial end of the anchoring means in the
bore when the anchoring means is in place.

15 ~~7. An anchoring means for a component for fitting~~
to or in a bone, the anchoring means insertable in a
bore in a bone and having a seal (51) for sealing the
anchoring means in the bore at an end of the bore distal
to the end through which cement is injected for
cementing the anchoring means in place.

20 8. The anchoring means of claim 7, comprising a single
part (53).

25 9. The anchoring means of claim 7 or claim 8, the seal
(51) comprising an annular ring around the anchoring
means.

30 10. The anchoring means of claim 7 or claim 8, the seal
(51) comprising a cap (60) having an annular recess (61)
for engaging a resected end surface of the cortical bone
wall of the bone.

35 11. The anchoring means of claim 7 or claim 8, the seal
(51) comprising an inflatable "O"-ring (70).

12. The anchoring means of claim 11, the anchoring
means further comprising an internal passage (71)
connected to the "O"-ring (70).

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13. The anchoring means of any of claims 7 to 12, in which an additional seal is provided at the end of the anchoring means where cement is delivered, this seal having one or more cement delivery orifices.

5

14. The prosthesis of claim 4, further comprising means (5-10; 15-20; 35; 45, 46) for connecting the retaining elements (1, 2) and the pin (3) comprising a screw thread, a tapered clamping connection, or a click and/or snap connection.

10

15. The prosthesis of claim 4, further comprising means (45, 46) for connecting the retaining elements (41, 42) to the pin (43), the means (45, 46) comprising a drawing plate (46) and a wire of memory metal, the wire of memory metal (45) having a first end thereof connected to a medial end of the pin (43) and a second end thereof connected to the drawing plate (46), the drawing plate (46) in mounted condition abutting against the outer side (f_o) of the femur (F) at the location of the lateral end of the femoral bore, the wire of memory metal (45) tending to shorten at body temperature to effect a tensile stress in the thread (45).

15

20

16. A method of fitting a joint prosthesis comprising inserting the joint prosthesis through an extra-medullary bore in a bone (F) from a position distal to the intended position of the prosthesis, and mounting a tapered anchoring means for the joint prosthesis in the bore such that its narrow end is remote from the joint when mounted.

25

30

17. A component for fitting to or in a bone, the component having an anchoring means insertable into a bone cavity and radially expandable in the cavity such that the anchoring means has a tapered configuration, with the narrow end of the taper furthest from the

35

component.

18. A method of anchoring a component to or in a bone, the method comprising inserting an anchoring means into
5 the bone cavity and radially expanding the anchoring means in the cavity such that the anchoring means has a tapered configuration, with the narrow end of the taper furthest from the component.

10 19. The prosthesis of claim 17 or the method of claim 18, wherein the anchoring means comprises a pin (3) and one or more retaining elements (1, 2), at least one of
the pin (3) and/or retaining element(s) (1, 2) being tapered, the pin (3) and retaining element(s) (1, 2)
15 being inserted in the bore and moved relative to one another, substantially in the direction of their major axes, such that the diameter of the anchoring means is increased.

20 20. A method of cementing an anchoring means in a bore in a bone (F) comprising inserting the anchoring means in the bore, sealing one end of the bore in order to prevent cement from escaping from the bore via that end, and injecting cement into the other end of the bore.

25 21. A prosthesis having an anchoring means configured for mounting in an extra-medullary bore in a bone (F), one end of the anchoring means being provided with an annular seal (51) through which cement may be forced
30 into the bore in use.

22. A method of anchoring a prosthesis in an extra-medullary bore in a bone (F), comprising locating a tapered anchoring component in the bore, sealing the
35 bore opening, and forcing cement under pressure into the bore with the anchoring means positioned therein.

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23. A hip prosthesis having an anchoring means for supporting the prosthesis in an extra-medullary bore in a femur, the anchoring means being tapered away from the prosthesis and extending only part way through the
- 5 femur.
-

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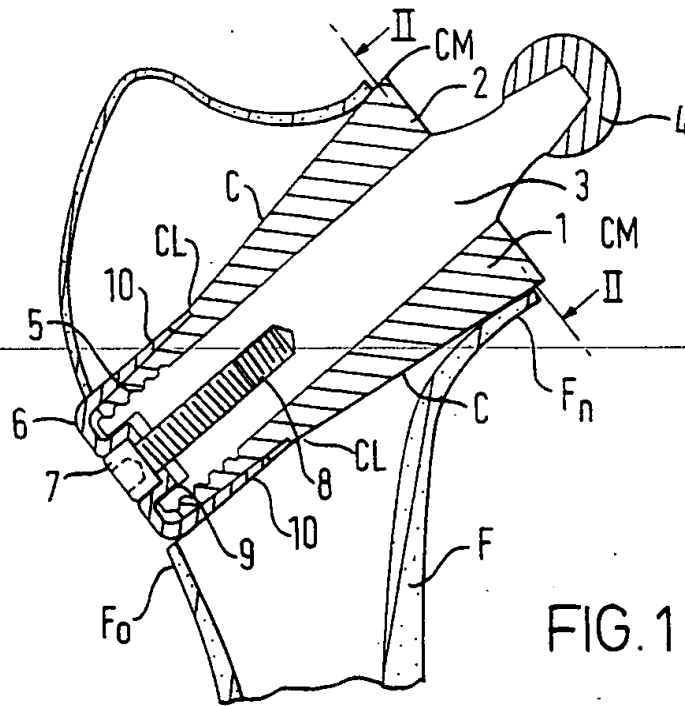


FIG. 1

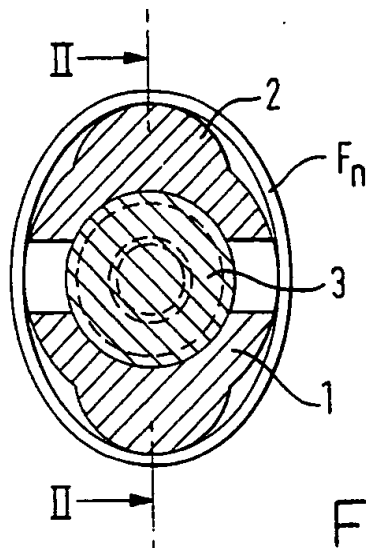


FIG. 2

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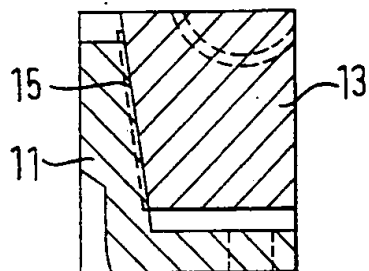


FIG. 5

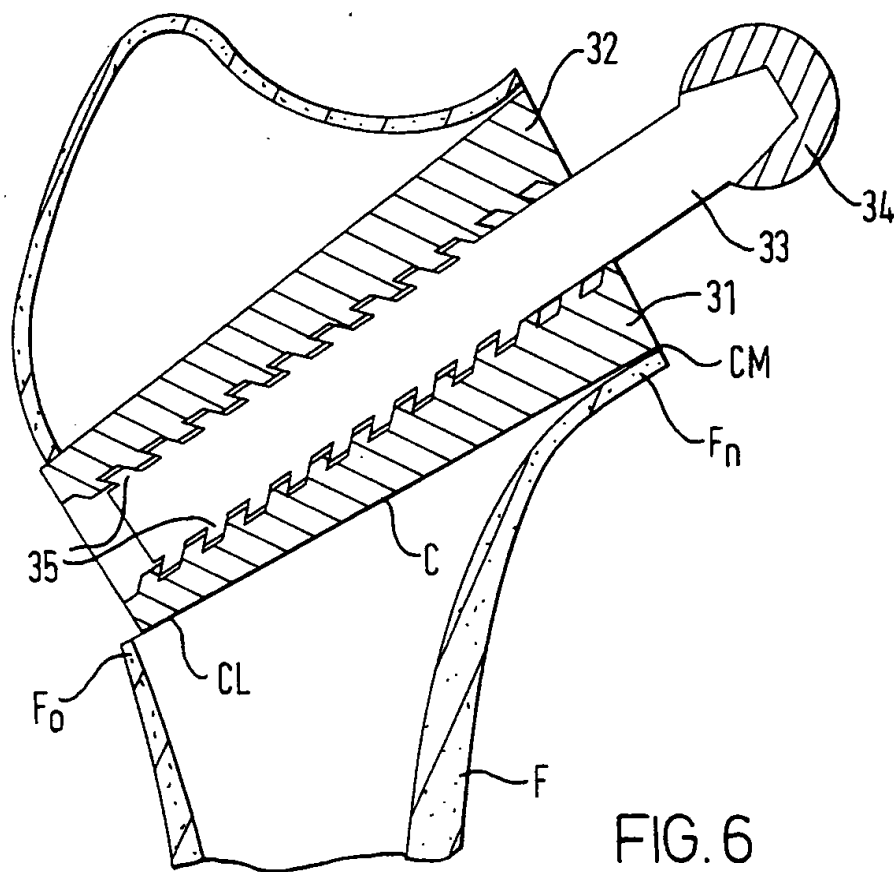


FIG. 6

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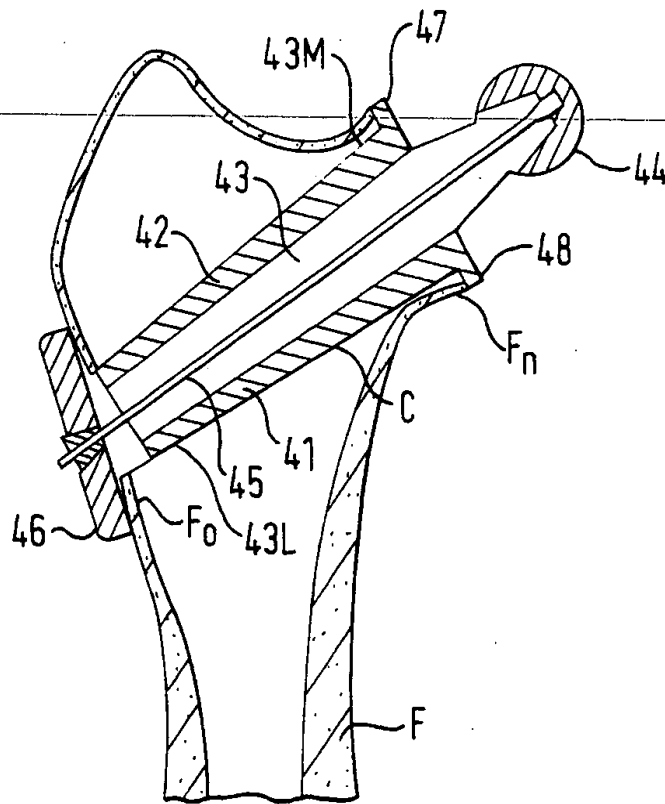


FIG. 7

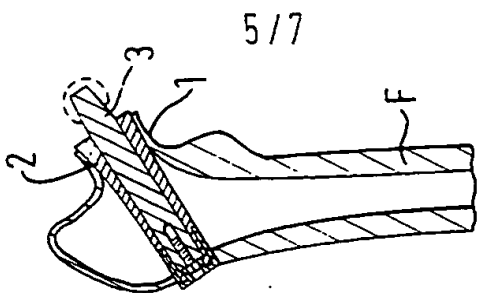


FIG. 8e

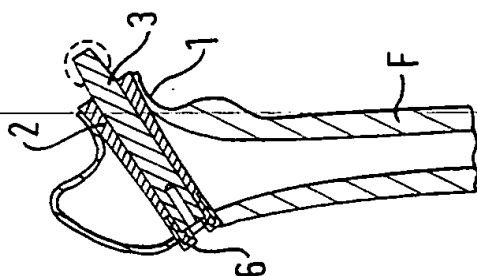


FIG. 8d

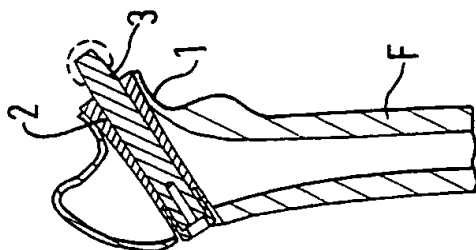


FIG. 8c

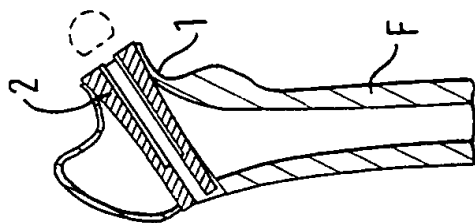


FIG. 8b

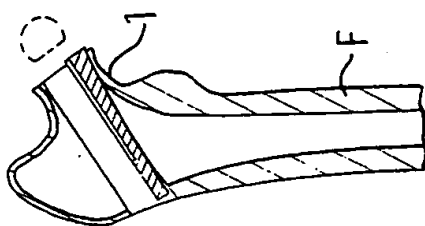


FIG. 8a

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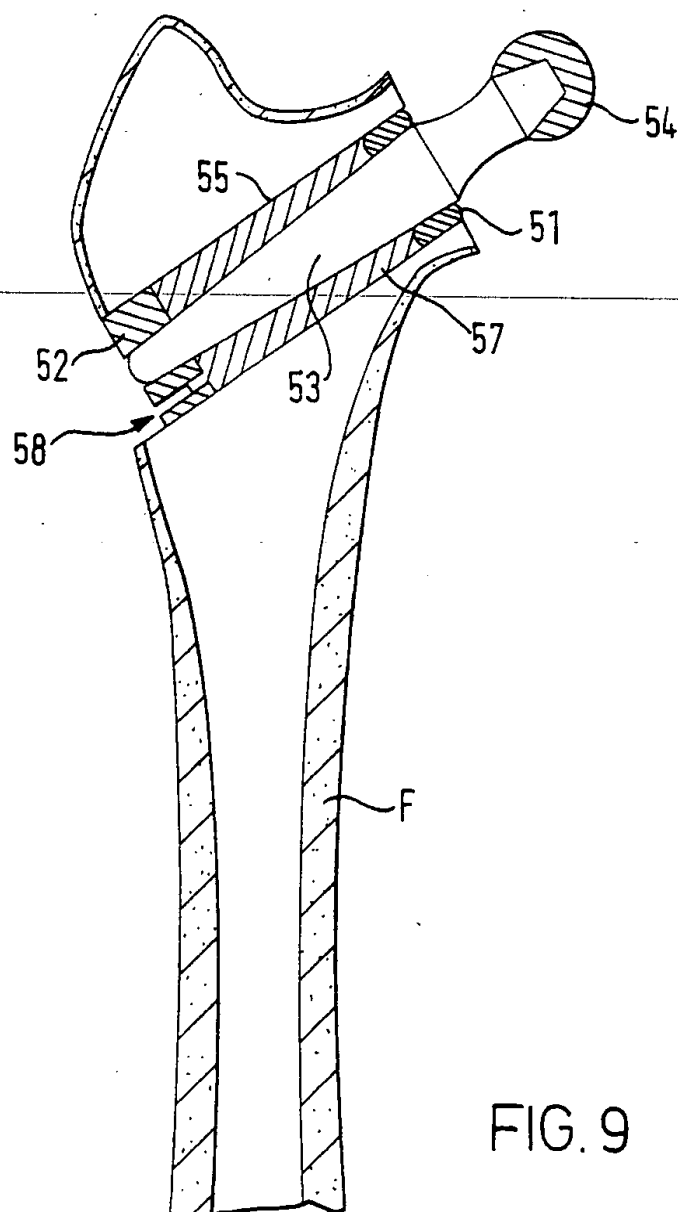


FIG. 9

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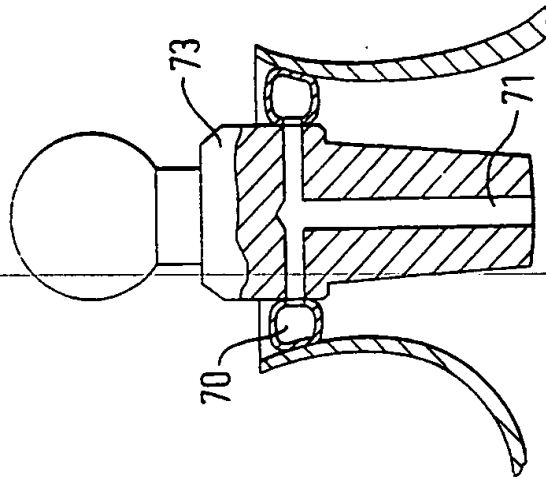


FIG. 11

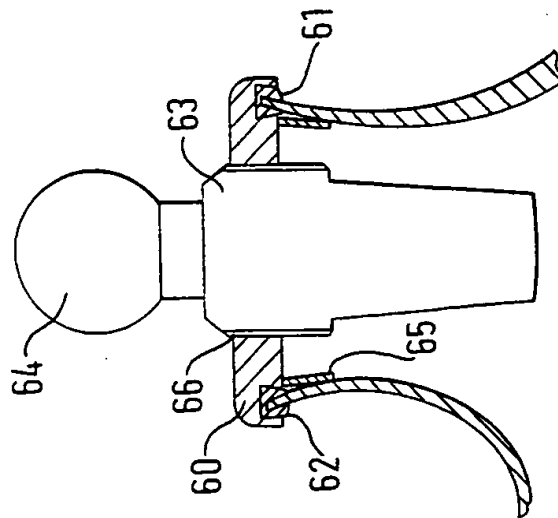


FIG. 10

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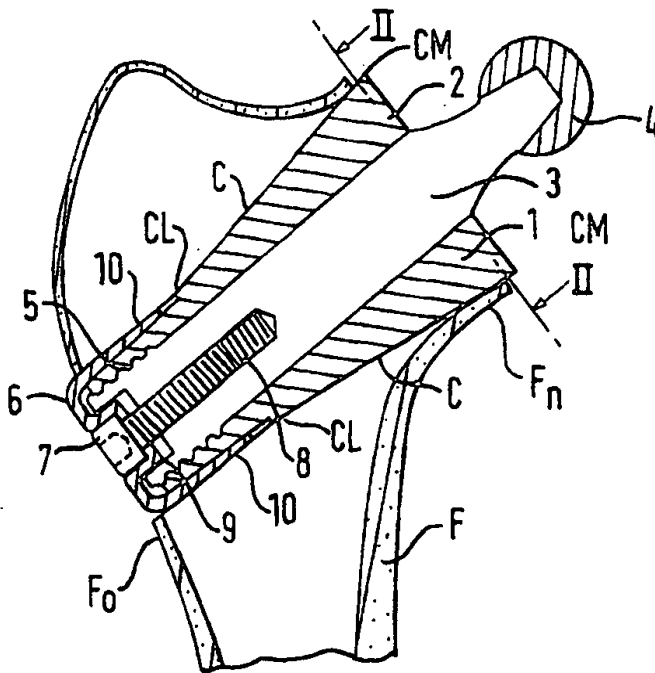
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61F 2/36, 2/46	A3	(11) International Publication Number: WO 00/09038 (43) International Publication Date: 24 February 2000 (24.02.00)
(21) International Application Number: PCT/GB99/02628 (22) International Filing Date: 10 August 1999 (10.08.99) (30) Priority Data: 1009832 10 August 1998 (10.08.98) NL (71) Applicant (for all designated States except US): NOVARTIC- ULATE B.V. [NL/NL]; Venetichof 61, NL-1019 NB Am- sterdam (NL). (71) Applicant (for ZW only): DAVIES, Christopher, Robert [GB/GB]; 9 Montpelier Villas, Brighton BN1 3DH (GB).	(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), DM, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(72) Inventors; and (75) Inventors/Applicants (for US only): KRIEK, Hans, Rudolf [NL/NL]; Venetichof 61, NL-1019 NB Amsterdam (NL). VERDONSCHOT, Nicolaas, Jacobus, Joseph [NL/NL]; Fransestraat 22, NL-6524 JB Nijmegen (NL). SPIERINGS, Petrus, Tarasius, Josephus [NL/NL]; Madoerastraat 27, NL-6524 LH Nijmegen (NL). (74) Agent: FRANK B. DEHN & CO.; 179 Queen Victoria Street, London EC4V 4EL (GB).	Published With international search report. (88) Date of publication of the international search report: 21 September 2000 (21.09.00)	

(54) Title: ANCHORING MEANS FOR A JOINT PROSTHESIS OR OTHER COMPONENT

(57) Abstract

An anchoring means for a joint prosthesis (4) tapers in a direction away from the joint prosthesis (4) but may be mounted in a bore through an inlet opening distal from the joint to be replaced. The anchoring means may comprise a tapering pin (53) which is cemented in place. Alternatively, the anchoring means may comprise a pin (3) and one or more retaining means (2, 3) which can be placed in the bore separately and manoeuvred such that the anchoring means tapers. Thus, a tapering anchoring pin is provided for a minimally invasive joint replacement technique.



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International Application No
PCT/GB 99/02628

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F2/36 A61F2/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 89 11837 A (ALBREKTSSON) 14 December 1989 (1989-12-14) abstract; figures 1A,3-5,12-23	1
Y	US 4 714 478 A (FISCHER) 22 December 1987 (1987-12-22) the whole document	1,2,23
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A		4,14,17, 19
A	GB 2 250 919 A (RODNYANSKY) 24 June 1992 (1992-06-24) page 21, line 10 -page 23, line 9; figure 6	1

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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Int. Patent Application No
PCT/GB 99/02628

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A	EP 0 791 342 A (ESKA IMPLANTS) 27 August 1997 (1997-08-27) the whole document	1,2,17, 23
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A	FR 2 724 310 A (MEDINOV) 15 March 1996 (1996-03-15) abstract; figures	4,19
A	US 4 728 335 A (JURGUTIS) 1 March 1988 (1988-03-01) abstract; figures	5
A	EP 0 094 829 A (FIELD) 23 November 1983 (1983-11-23) claim 1; figure 4	15
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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/02628

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5 571 203 A (MASINI) 5 November 1996 (1996-11-05)	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 99/02628

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 16, 18, 20, 22
because they relate to subject matter not required to be searched by this Authority, namely:
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2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

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2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
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4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6,14,15,17,19,23

A joint prosthesis, in particular a hip prosthesis, having an anchoring means being tapered in a direction away from the joint and being so small and/or slender that it is mountable through an extra-medullary bore in a bone from an opening distal from the joint.

2. Claims: 7-13,21

A prosthetic anchoring means insertable in a bore in a bone, having a seal for sealing the anchoring means in the bore at an end of the bore distal to a cement injection end.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. Application No

PCT/GB 99/02628

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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